

## **P.19      Demonstration of Electro-Chemical Remediation Technology**

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### **Abstract**

Many U.S. Department of Energy (DOE) nuclear weapons complex sites contain soil and groundwater contamination that challenge efficient and cost-effective treatment, stabilization, or removal techniques of the contamination. Current remediation efforts often involve bulk excavation of the contaminated materials, which are then transported to a separate facility for treatment. DOE is constantly seeking remediation methods that will significantly reduce costs, schedules, and risks to workers, the public, and the environment.

A team composed of The Providence Group, Inc. (TPG), Weiss Associates (WA), and ADA Technologies, Inc. (ADA) has been formed to demonstrate the use of ElectroChemical Remediation Technologies (ECRTs), and in particular the Induced Complexation (IC) Process, for in-situ remediation of soils contaminated with mercury, other heavy metals, and radionuclides.

The soil/groundwater/sediment system can be considered an electrochemical system. During the patented ECRTs-IC process, a proprietary AC/DC power converter is used to introduce electrical energy into the soil/ground water/sediment system targeted for clean up, using electrodes placed in the ground. The soil, in effect, acts much like a capacitor, analogous to the induced polarization geophysical process, storing energy and later releasing it. This energy is thought to be stored in the matrix double layer. The electrical discharge of this energy causes electrolysis and reduction-oxidation (ReDox) reactions at the pore scale, which provides the metal complexing agents. The voltage gradient imposed on the matrix provides the impetus needed to mobilize metallic contaminants to the electrodes where they are deposited. These electrodes may then be removed for recovery of the recyclable metals and/or disposal of the remaining materials. Already, the ECRTs-IC technology has been demonstrated successfully in the field. At a site in Union Canal, Scotland, approximately 400 mT of sediment with an initial total mercury concentration of 33 – 1,570 mg/kg (average concentration: 243 mg/kg) was reduced to a final average total mercury concentration of 6 mg/kg within 26 days of ECRTs-IC operation. A total of 76 kg of mercury was plated onto the power electrodes (anodes and cathodes) during the remediation. A mass balance analysis based on the field data showed reasonably good agreement between the total mercury plated onto the electrodes and the pre- and post-remediation sediment concentrations. Other case histories show reductions in concentrations of other metal contaminants. Thus this technology also shows promise for in-situ remediation of those radionuclides that behave as metals.

The purpose of the current research is to demonstrate, first as a large-volume bench-scale test and then in a pilot-scale field demonstration, that ECRTs are a viable, cost-effective method for remediating mercury contaminated soils at DOE weapons complex sites. The ECRTs-IC process was developed by P2-Soil Remediation, Inc. in Stuttgart, Germany. Weiss Associates holds the exclusive North American license for application of ECRTs. During the performance of this contract, Weiss Associates will be responsible both for reducing the technology to a large-volume bench-scale demonstration and for proving that the ECRTs-IC process can be used to treat in-situ an actual DOE field site at the Y-12 plant in Oak Ridge, Tennessee. ADA Technologies, Inc. has over eight years of experience in the development and commercialization of technologies for the removal of mercury from gaseous, liquid, and solid waste streams. In addition to developing the test protocols and work plans, ADA Technologies, Inc. will be responsible for stabilizing the mercury and other contaminants collected from the electrodes into a form that is acceptable for waste treatment. The Providence Group, Inc. has extensive experience in field remediation operations, including experience working with soil contaminated with heavy metals and radionuclides. For the purposes of this contract, The Providence Group, Inc. will manage the overall project, maintain the flow of communication, and ensure that data quality objectives are met. TPG brings to the team experience performing remediation projects at the Oak Ridge DOE facilities as well as a local presence to coordinate preparation and execution of the deployment at Y-12.